TO CATCH A CHILD'S IMAGINATION II
Educational Update on CAN DO

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Closing the Loop

ABSTRACT

In the field of educational activities, not unlike financial investment, high return is usually achieved only in ventures with high risk. Innovative and exotic activities such as the GAS program will invariably carry significantly more danger of failure and delay than more conservative and conventional endeavors, although the rewards can be greater also. Planning to manage such risks and building in flexibility with strong alternatives should be part of any comprehensive program.

At the G.A.S. Symposium last year, the Charleston County Public School CAN DO Project outlined an ambitious educational program revolving around the photography of Comet Halley from the Shuttle using a GAS canister. The target flight was STS 61-E scheduled for a March, 1986, launch. Such strict time constraints and highly specific mission requirements made the CAN DO program even more risky than normal. In spite of this, almost all of the planned educational goals were achieved, even after the postponement of all Shuttle activities in January of 1986.

This follow-up paper summarizes the effects of events on the program as proposed and the attempts to carry out as many of the activities as possible. It is hoped that this paper will suggest constructive ways in which to cope with the delays and mishaps that are the invariable lot of pioneers who break new ground and attempt the new and untried.

OCTOBER, 1985 to JANUARY, 1986

At the time of the GAS Symposium in October, 1985, the CAN DO project was still far from assured of being on an appropriate shuttle flight at all. Under the rules governing the GAS queue, whether or not G324 would be eligible for a flight by March depended on several factors including whether the GAS Bridge had flown. Worse yet, the only appropriate flight, STS 61E, was already seriously overweight and no GAS payloads were planned for it, regardless of number. Despite the gloomy outlook, work proceeded in hopes of a change since the only alternative would have been to abandon all hope of photographing Comet Halley.

At the invitation of Dr. Mal Neidner, the CAN DO team was able to present its plans to the astronomers working on STS-61E's primary payload, the ASTRO ultraviolet observatory which was planning to study Comet Halley and other objects. The scientists of the ASTRO HALLEY SCIENCE TEAM, after a careful study, decided that the CAN DO camera package could serve as a useful auxiliary to their own wide field camera system pending a successful resolution of the weight problem. The subsequent removal of a communication satellite because of launch window incompatibility made the additional weight available. Suddenly, CAN DO ceased to be a GAS payload and instead became an auxiliary part of the ASTRO payload utilizing GAS technology and with GAS program technical support. From this point, the main thrust was to modify the original design to make the payload as compatible as possible with the ASTRO mission goals. These design changes, to be discussed in detail in a separate paper, included the addition of an ultraviolet camera and the design and construction of a fused silica window to allow photography at ultraviolet wavelengths. In addition, steps were taken to improve mission life in order to provide photographic coverage for more of the planned mission duration.

To insure a better percentage of "hits" than would be possible with the automatic digital video "comet detector" of the original design, it was decided to have the cameras under active Astronaut control. The cameras would be activated only at those times when the payload was oriented towards the comet and conditions suitable for good photography. Two members of the STS 61E crew, Pilot Dick Richards and Mission Specialist David Leestma came to Goddard Space Flight Center and spent a day becoming fully acquainted with the payload and the control system.

Also during this period, the payload was finished and fully tested in facilities at both Langley Research Center and Goddard Space Flight Center. All tests were successfully completed and the payload fully integrated in time to be delivered to the Kennedy Space Flight Center by the flight deadline.

With the flight seemingly assured, the NASA Educational Affairs Office, under the direct guidance of the Langley Research Center Educational Affairs Division, took an active role in publicizing the flight nationwide in an effort to recruit the greatest possible number of student participants. A twenty minute video tape was produced outlining the upcoming flight and giving the information for schools to sign up for both the Comet Halley Student Ground Research Team and for the planned educational packet to be made up using the CAN DO photos and other material.

By January, the tape was finished and a brochure already at the printer for planned national distribution. The day of the CHALLENGER tragedy was the exact day that the payload was scheduled to be delivered to the Vehicular Assembly Building for loading aboard the COLUMBIA.

CARRYING ON

From the very moment of the Challenger disaster, there was never a serious debate about the necessity of continuing the program. Despite assurances received from many people within NASA determined to continue with the GAS program as soon as possible, there was no possible hope of any space flight during the period of Comet Halley. While long range plans to develop other appropriate future deep-space photographic targets were immediately begun, the more difficult and pressing problem was to decide how to salvage as much as possible from educational activities already under way.

The primary motivation for an aggressive alternative effort was not the loss of the scientific data. From the beginning, CAN DO has been designed as an effort to obtain good quality wide-field color visible light photographs of the Comet. While it was hoped that these photographs would compliment the other photographs being taken throughout the world by such groups as the International Halley Watch, it was clearly recognized that an army of amateur and professional astronomers would be bringing an impressive array of sophisticated equipment to bear on similar goals. The loss of the CAN DO photos was not apt to leave any very serious gap in that coverage. The program's primary goal had always been as a vehicle for student involvement and education and it was in this same area that the real loss was likely to occur.

The CAN DO project was primarily targeted at the middle school level, grades 6-8, which is a crucial period when the child first begins to develop many attitudes which he will carry on into adulthood. The typical child at this age has often not been confronted with significant tragedy or disappointment. Efforts had been successful in getting the Challenger launch carried live in a majority of classrooms in the area in hopes that the "Teacher in Space" flight would serve as a good introduction to "their" upcoming flight. Instead, these students were inadvertently brought into a situation where they felt a real personal involvement in a very dramatic and tragic event. The impression was profound, and it was felt that any action would now serve as an example, good or bad, on how to deal with tragedy and disappointment. Thousands of students now felt deeply involved with the space program and hopes and excitement had been built for a project that could not be completed as planned. To passively admit defeat and suspend the project would serve as one sort of lesson. To pick up the pieces and carry on in the best possible manner would be another very different lesson much more in the spirit of the Challenger crew and the space program itself. Therefore, with this in mind, the search for constructive alternatives was begun.

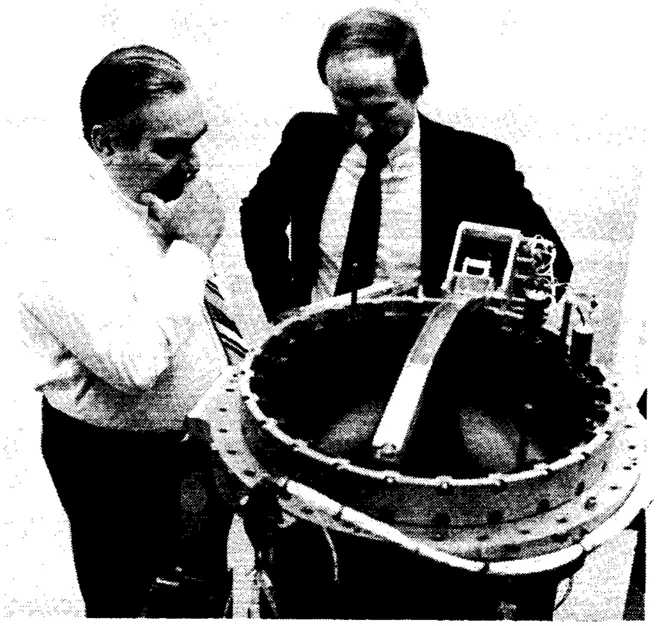

Fig. 1: Director of Special Payloads Leonard Arnowitz and Astro Mission Manager Ron Kinsley inspect the finished CAN DO payload.

JANUARY 28, 1986 to APRIL 1, 1986

The first week following January 28 was taken up with the immediate details of closing down the space flight program including the retrieval of the payload from the Kennedy Space Flight Center. This was followed by an immediate review of the educational program in light of the new circumstances. The secondary activities including: the interviewing of senior citizens who remembered Comet Halley from 1910; the preparation of a time capsule by the Young Astronauts to be opened at the time of Halley's next apparition; the construction of a 17½ inch telescope by a local middle school; and the program of public and student "sky parties" to observe the comet and associated meteor showers were already either underway or completely planned. These programs had been specifically intended to be independent of, though complimentary to, the Space Shuttle effort and no direct impact was anticipated. In fact, these separate activities became even more important because they could be completed successfully even without pictures of the comet being made from space.

On the opposite end of the spectrum, activities specifically geared to the orbital environment such as the eleven student experiments included with the payload had to be indefinitely postponed pending resumption of Shuttle activities. All of these experiments were designed to test the effect of the micro-gravity or radiation effects of low Earth orbit on various material, both man-made and biological. No meaningful substitute could be devised and it is to the credit of the 28 young students involved that they accepted their disappointment with good grace and understanding that belied their ages.

The areas where alternatives could salvage activities were those based on the actual acquisition of photographs. These included the concurrent ground-based photography by the students for later comparison to the space-based photos, the student evaluation and interpretation of the CAN DO photos, and the publication of a post-flight educational packet. The importance of the Shuttle photos were two-fold. First, to provide pictures for comparison taken in an environment not normally available to students and such that the results might, in fact, show meaningful differences to pictures made from the ground. Secondly, to provide added interest and excitement by making their "backyard" efforts part of a larger program the included exotic activities such as space flight.

Fig. 2: Chief Machinist Cliff Harvey and the author brief STS-61E Mission Specialist David Leestma and Pilot Dick Richards on the operation of the payload.

CAN DO II - THE SEARCH FOR ALTERNATIVES

Shortly before January, a team from CAN DO and the National Geographic Society had traveled to the McDonald Observatory in Fort Davis, Texas, to conduct final film tests under darker, clearer skies than could be obtained in South Carolina. These tests had not only made it possible to select the best film, but had indicated the potential of the film and lenses to return high quality photographs under the nearly ideal conditions. One possible alternative would be to return to Fort Davis during March to take comparative photos. Other observatory sites considered were located in Hawaii and Chile, although all observatory locations were already heavily committed during the peak Comet Halley period.

During the same period, several advisors mentioned that there were two high altitude flying observatories operated by NASA which were being deployed to the Southern Hemisphere during this period. These potentially seemed to offer the best opportunity of achieving a "near-space" environment and meeting the criteria for generating interest and providing meaningfully different photos. Efforts to make contact finally resulted in discussion being opened with the Gerard P. Kuiper Airborne Observatory operated by Ames Research Center at Moffett Field, California. Observatory Director, Louis Haughney, and Mission Director, David Brown, were sympathetic and interested, but several serious handicaps make it unlikely that an effort could be launched. First, the Kuiper was busy preparing for the deployment in just a few weeks and no wide-field cameras had ever been mounted on the Kuiper. No hardware existed for such a mounting nor appropriate control equipment, and it was unlikely that any could be designed in time to be fitted and tested before the aircraft was already at Christchurch, New Zealand. Secondly, the Kuiper has its primary responsibility to the Astronomers for which each flight is dedicated. Unless it could be conclusively and unequivocally proven that the mounting of the CAN DO equipment in no way interfered with the operation of the 36-inch telescope, the equipment could not be used. This, for example, precluded the possibility of including any internal heat in the cameras as a heat source near the head ring of the telescope would completely distort data being collected by the extremely sensitive infrared sensors. This presented a considerable obstacle since no one was certain that any camera would function in the anticipated -55°C temperatures at 41,000 ft. Thirdly, CAN DO had not funds available to send a team to far-off New Zealand and support them for the time necessary to mount such a campaign, especially one so apt to not be allowed to operate. It would have been more than understandable if, in view of the time and mission pressures involved, the Kuiper Observatory had dismissed the idea with polite good wishes and regrets that this could not have been brought up when there was time to adequately consider such a major undertaking. Instead, they were encouraging and supportive and made it clear that if we could design equipment that would work without interference to the other apparatus in time, and manage to get to Christchurch, they in turn would do everything in their power to get us up and help us get our pictures.

Once more, the design team was challenged with a fourth major redesign with two weeks in which to have the plans submitted and approved at Ames. Another paper at this symposium will give the technical side of this equipment, but I want to note here that not only were the impossible deadlines met but the

equipment performed faultlessly and created no problems for the other researchers. The Nikon cameras also rose to the occasion and experienced not one failure in cold and near vacuum far in excess of that for which they were designed. The third problem, that of funding, was solved through the continued unflagging support of the National Geographic Society, the ASTRO mission team at Marshall Space Flight Center and the NASA Education Office, who jointly provided support for a team of three to operate from New Zealand.

ABOARD THE KUIPER

The team that traveled to Christchurch included the CAN DO Principal Investigator, Chief Engineer and "Teacher-in-Space" finalist, Nikki Wenger. Ms. Wenger was chosen to insure that the experience would have a direct route back to the classroom. As part of their duties, the "Teacher-in-Space" finalists spend much of their time touring schools throughout the country and making presentations about many different NASA activities. Between April 6 and April 21, the team made six flights aboard the Kuiper Airborne Observatory and after their departure, the CAN DO equipment was used by Kuiper personnel and several university groups. Unfortunately, this period was coincident with the surprising period when Comet Halley virtually "turned off" and the comet was dim and showed only a few degrees of tail. In spite of these less than ideal conditions, good quality photographs were obtained on every comet flight. One set showed a dramatic "tail disconnection" event. In addition, some of the first ever ultraviolet wide-field photographs were made. Overall, the results obtained from aboard the Kuiper were not dissimilar to the anticipated results from aboard the Shuttle, with the exception that the Shuttle flight would have been at a time when the comet was larger and brighter. From a photographic point of view, there seemed to be little difference between the Kuiper's eight mile altitude and the Shuttle's low Earth orbit in either the visible light or the ultraviolet.

The reception to the photographs and the project was enthusiastic and the CAN DO activities were extensively covered by the New Zealand press. Members of the team, especially Ms. Wenger, were able to visit several schools both in the Christchurch area and as far away as Australia. The Kuiper crew themselves were enthusiastic about the photos and hope to have similar coverage on future missions.

Fig. 3: Teacher-in-Space Finalist Nikki Wenger mounting the cameras in the telescope bay of the Kuiper Airborne Observatory.

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Fig 4: CAN DO Chief Engineer Tom O'Brien and the author operating the control equipment on board the KAO.

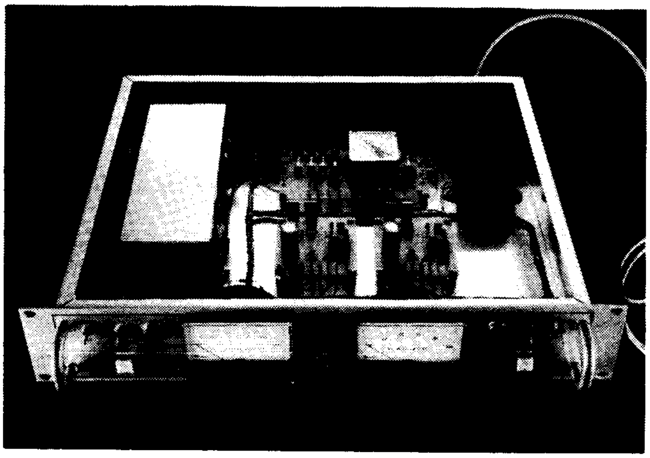

Fig. 5: The Control Unit

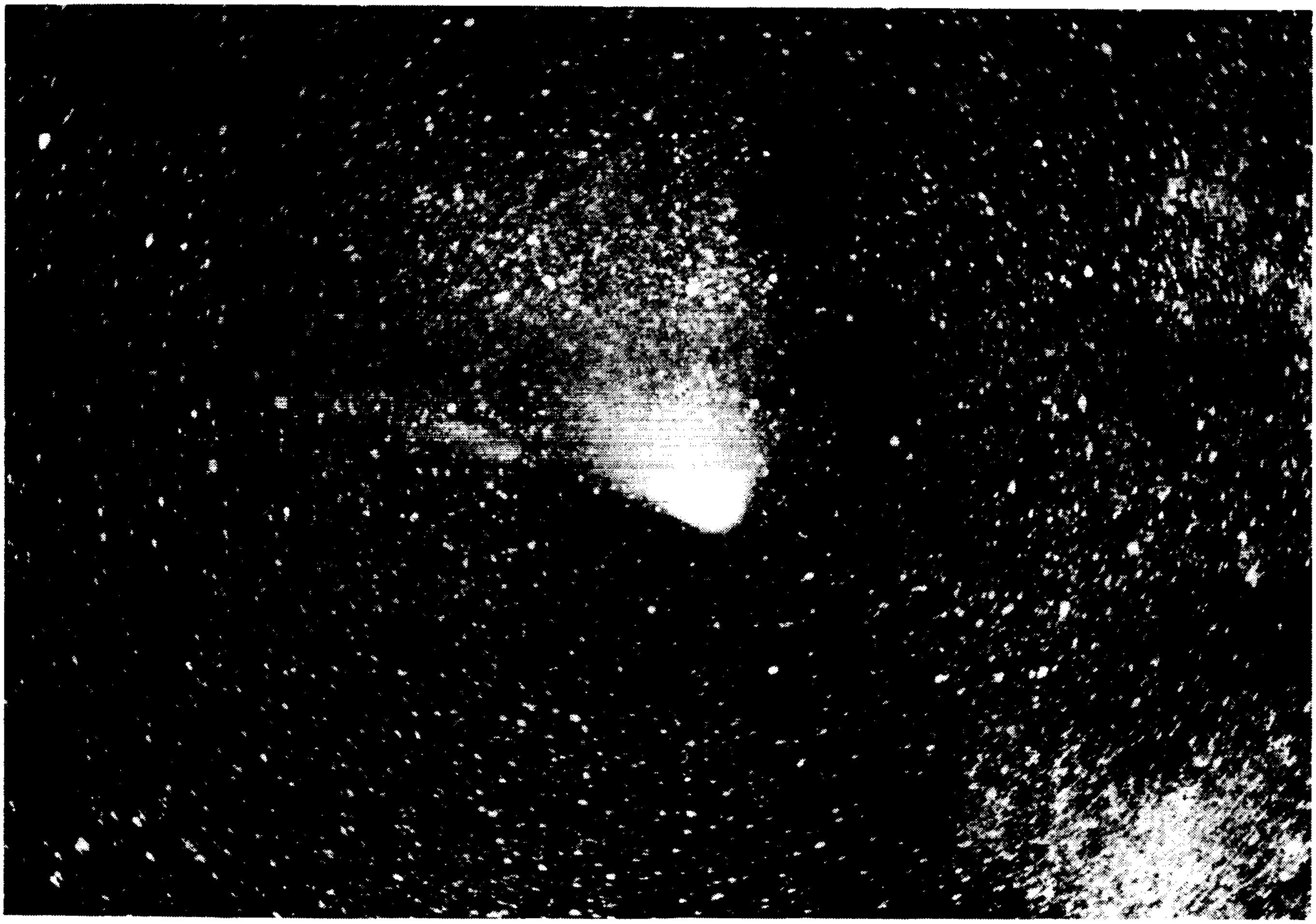

Fig. 6: Photograph of Comet Halley taken the night of April 8/9 showing a disconnection of the ion tail. Black and white reproduction of color original. 105mm f 2.5 Nikkor lens/Ektachrome EES film processed in C41/5 minute exposure.

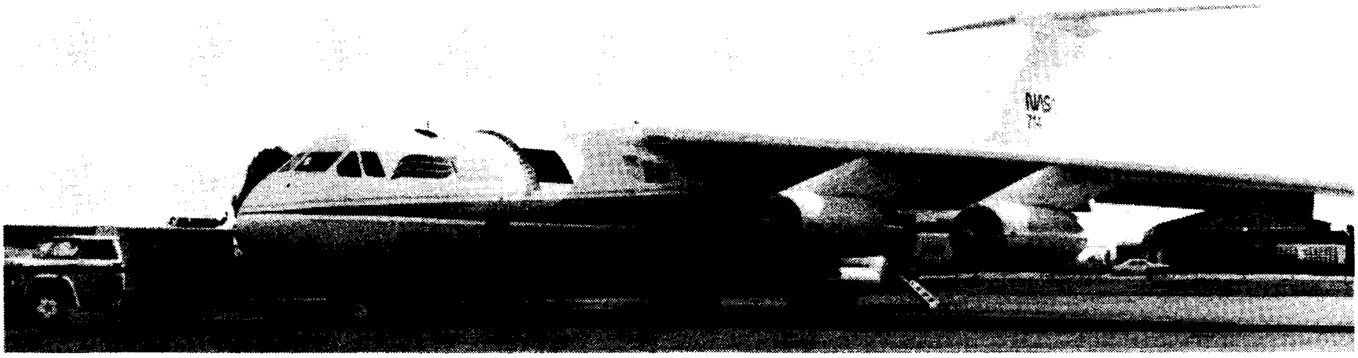

Fig. 7: KAO at Christchurch.

EDUCATIONAL SUMMATION

Looking back over the originally planned activities, the final scoreboard shows the following:

PRIMARY STUDENT ACTIVITIES

Junior Design Team . .	Completed before January
Student Space Experiments	Postponed
Student Photo Evaluation.	Packets in preparation using Kuiper photos

SECONDARY STUDENT ACTIVITIES

Historical Research and Interviews.	Successfully completed
Young Astronaut Time Capsule	Successfully completed
Sky Parties	Successfully completed, terrific public interest
Ground-Based Studies	Handbooks distributed, success somewhat limited by poor comet performance
Radio Monitoring of Shuttle	Postponed (Radio groups successfully used to link sky party locations)
Construction of 17.5 inch telescope . .	Completed in time for sky parties

CONCLUSION

While it is impossible to pretend that the loss of such a unique opportunity to photograph the comet from space was not a disappointment, the experience still was a very positive one. Educationally, we were able to complete almost all of the original goals. We developed an alternative activity that has future potential in its own right. We hopefully presented a positive example of perseverance in the face of adversity that may stand some young student well in the future. Best of all, we now have a fully built and tested payload and considerable practical experience in "near-space" photography. When our turn comes again, we will be ready to go. Older and wiser, we should be able to construct a new and better program to reach even more students. Fortunately, each new year brings fresh astronomical targets and a new group of students.